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Review of Winter Skate (*Leucoraja ocellata*) in the Northern Gulf of St. Lawrence in Support of a Recovery Potential Assessment

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ABSTRACT

In 2005, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) first assessed Winter Skate (*Leucoraja ocellata*) of the northern Gulf of St. Lawrence (nGSL) as data-deficient. In April 2015, COSEWIC re-assessed Winter Skate and revised population structure by grouping nGSL and southern Gulf of St. Lawrence (sGSL) fish in a new designatable unit (DU), the Gulf of St. Lawrence DU with the status endangered. This re-definition of the DU was mainly based on the spatial distribution of Winter Skate and potential heritable traits that indicate significant adaptations. Compared to other populations, Winter Skate in the sGSL mature at a much smaller size and earlier age, have a much shorter maximum length, occur in shallower and warmer water in summer, and differ in morphological characters (teeth and jaws) related to feeding.

This document revisited available data in the nGSL to confirm records of Winter Skate, and to seek information to help determine if these skates exhibit characteristics similar to the sGSL type, i.e. early-maturing, found in warm and shallow waters in summer.

Records of Winter Skate in the nGSL were reviewed using:

1) available survey photos,
2) survey catches with depth and geographic location data, and
3) individual weight-length data.

Extensive sampling of the nGSL indicates that Winter Skate occur very rarely in this region. The very limited number of individuals (n = 3) for which biological information and maturity data are available would indicate that the early-maturing sGSL Winter Skate type can be found in the St. Lawrence Estuary, NAFO Division 4T, and that the late-maturing type is present on the west coast of Newfoundland and in the Bonne Bay fjord, Division 4R. The confirmed Winter Skate of the early-maturing type in the Estuary may be a vagrant individual caught outside of the normal range of sGSL Winter Skate.

Revue de la raie tachetée (*Leucoraja ocellata*) dans le nord du golfe du Saint-Laurent en appui à l'évaluation du potential de rétablissement

RÉSUMÉ

En 2005, le Comité sur la situation des espèces en péril au Canada (COSEPAC) a d'abord évalué la raie tachetée (*Leucoraja ocellata*) du nord du golfe du Saint-Laurent (nGSL) comme faisant partie de la catégorie « données insuffisantes ». En avril 2015, le COSEPAC a réévalué la raie tachetée et révisé la structure des populations en regroupant les raies tachetées du nord et du sud du golfe du Saint-Laurent (sGSL) en une nouvelle unité désignable (UD), la population du golfe du Saint-Laurent. Cette population a été désignée « en voie de disparition ». Cette redéfinition des UD a été principalement basée sur la répartition géographique de la raie tachetée et sur des variations de caractères héréditaires qui sont indicatrices d'adaptations importantes. Comparé à d'autres populations, les raies tachetées du sGSL atteignent la maturité sexuelle à une taille beaucoup plus petite et à un plus jeune âge, ont une longueur maximale beaucoup plus courte, se trouvent dans des eaux moins profondes et plus chaudes en été, et diffèrent dans certains caractères morphologiques (dents et mâchoires) liés à l'alimentation.

Plusieurs sources de données ont été revues pour tenter de confirmer les mentions de raie tachetée dans le nGSL et pour revoir les informations pouvant permettre de déterminer si ces individus possèdent les caractéristiques propres au type de raie tachetée du sGSL, c'est-à-dire à maturation précoce et qui se retrouve dans des eaux chaudes et peu profondes en été.

Les données de raie tachetée dans le nGSL ont été revues en utilisant :

1) des photos prisent lors de relevés de recherche,
2) les données de capture en fonction de la profondeur et de de leur localisation géographique lors de relevés, et
3) des données individuelles de poids-longueur.

Un échantillonnage intensif du nGSL indique que la raie tachetée ne se retrouve que très rarement dans cette région. Le nombre très limité d'individus (n = 3) pour lesquels des données sur la maturité sont disponibles indiquerait que le type de raie tachetée du sGSL à maturation précoce peut être retrouvé dans l'estuaire du Saint-Laurent, division 4T de l'OPANO, et que le type à maturation tardive est présent sur la côte ouest de Terre-Neuve et dans le fjord de Bonne Baie, division 4R. Le seul spécimen de raie tachetée confirmée, du type à maturation précoce dans l'estuaire, pourrait être un individu errant capturé à l'extérieur de l'aire normale de distribution de la raie tachetée du sGSL.

INTRODUCTION

In 2005, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) first assessed Winter Skate (*Leucoraja ocellata*) in Canadian waters as four separate populations or Designatable Units (DU):

1) Southern Gulf of St. Lawrence (Endangered);
2) Eastern Scotian Shelf (Threatened);
3) Georges Bank-Western Scotian Shelf-Bay of Fundy (Special Concern); and
4) Northern Gulf-Newfoundland (Data Deficient).

The first assessment pre-dated the COSEWIC Guidelines for Recognizing DUs (COSEWIC 2011) which was the basis for a second assessment. In April 2015, COSEWIC re-assessed Winter Skate as three DUs:

1) the Gulf of St. Lawrence (GSL; endangered);
2) Eastern Scotian Shelf and Newfoundland (ESSN; endangered); and
3) Western Scotian Shelf (not at risk) (COSEWIC 2015).

The new Gulf of St. Lawrence DU, is composed of the former Southern Gulf of St. Lawrence population and the northern Gulf portion of the former Northern Gulf - Newfoundland population. This re-definition of the DUs was mainly based on the distribution of Winter Skate which shows concentration in three areas: the Gulf of St. Lawrence, the Eastern Scotian Shelf/Southern Newfoundland, and the Western Scotian Shelf/Bay of Fundy/Canadian portion of Georges Bank. These concentrations being separated by considerable distances, it suggested three distinct populations. The COSEWIC assessment also stated that Winter Skate show variation in heritable traits that indicate significant adaptations.

Several studies (McEachran and Martin 1977, Swain et al. 2006, Kelly and Hanson 2013a,b) have shown that Winter Skate in the southern Gulf of St Lawrence (sGSL) have distinctive features relative to Winter Skate found elsewhere in the Northwest Atlantic. Compared to other populations, Winter Skate in the sGSL mature at a much smaller size and earlier age, have a much shorter maximum length, occur in shallower and warmer water in summer, and differ in morphological characters (teeth and jaws) related to feeding. Given these striking differences, Kelly and Hanson (2013b) proposed that Winter Skate from the shallow waters of the sGSL may represent an undescribed endemic species different from Winter Skate (*Leucoraja ocellata*) elsewhere.

Winter Skates are very rarely caught in summer surveys of the northern Gulf of St. Lawrence (nGSL) and misidentifications of skates are known to have occurred (Nozères et al. 2015, Dutil 2006). In the context of the *Species At Risk Act* (SARA), it is important to confirm records of Winter Skate in the nGSL, and to seek information to help determine if these skates exhibit characteristics similar to the sGSL type, i.e. early-maturing and found in warm, shallow waters in summer.

This document was prepared for a Recovery Potential Assessment (RAP) meeting on Winter Skate, Gulf of St. Lawrence population and Eastern Scotian Shelf – Newfoundland population.

WINTER SKATE IN THE NORTHERN GULF OF ST. LAWRENCE

For this review, the northern Gulf of St. Lawrence (nGSL) is considered to be the area covered by the DFO Quebec Region bottom trawl survey which includes Northwest Atlantic Fisheries Organization (NAFO) Divisions 4R and 4S and water depths of more than 183 m in Division 4T including the St. Lawrence Estuary (Figures 1 and 4).

HISTORICAL INFORMATION ON THE PRESENCE OF WINTER SKATE IN THE NGSL

Three Winter Skate collected from the Upper St. Lawrence Estuary (Kamouraska) (Figure 1), NAFO Division 4T, are reported in Bigelow and Schroeder 1953. These skates were initially identified as Little Skate but a later review by McEachran and Musick (1973) determined that historical Estuary and Gulf of St. Lawrence records of Little Skate were in fact Winter Skate.

Another confirmed specimen of Winter Skate was sampled in 1988 at Rivière-du-Loup (Figures 1 and 2), Upper St. Lawrence Estuary, NAFO Division 4T. It was caught in an eel trap set at a depth of 5 m. This skate, preserved in the Maurice Lamontagne Institute collection in Mont-Joli, is a mature male (based on clasper size) of 49.5 cm weighing 970 g. This relatively small mature individual would correspond to the sGSL early-maturing type of Winter Skate.

In the Canadian Museum of Nature collection, a Winter Skate (CMNFI 1981-0068.1) is reported to have been sampled in 1978 from Bonne Bay, a fjord located on the west coast of Newfoundland (Figure 1) opening in NAFO Division 4R. Approximately ten other Winter Skate have been confirmed captured from this fjord during an annual field course conducted by Memorial University between 2002 and 2010 (Wrobleski 2013, J. S. Wroblewski, Memorial University, Newfoundland, pers. comm.). Although this course is still ongoing, no Winter Skate have been captured between 2011 and 2015. Information on maturity was not collected, but a photograph (Figure 3) from one of the specimens shows a 54 cm immature male. An immature specimen of this size would be considered as the late-maturing type and not the sGSL Winter Skate early-maturing type.

NGSL AUGUST DFO BOTTOM TRAWL SURVEYS

SURVEY DESCRIPTION

Annual demersal trawl surveys were conducted in the nGSL in August since 1984. Surveys used a stratified random design, with stratification based on depth and geographic region (Figure 4).

Survey coverage includes NAFO Divisions 4R and 4S as well as strata deeper than 183 m (100 fathoms) in Division 4T, including the Lower St. Lawrence Estuary (Figure 1). Survey coverage varied over the time series. There was a first expansion in 1991 with the addition of 6 shallow strata in the 37-92 m depth range; 4 strata in Division 4R and 2 in Division 4S. A second expansion occurred in 2008 when coverage of Division 4T increased in the upstream part of the Lower Estuary with the addition of 4 strata in the 37-183 m depth range. Subdivision 3Pn was sampled from 1994 to 2003.

The research vessels conducting the survey were the *CCGS Lady Hammond* using a Western-IIA trawl from 1984 to 1990, the *CCGS Alfred Needler* using a URI (University of Rhode Island) shrimp trawl from 1990 to 2003 and in 2005. Since 2004, the surveys are conducted on the *CCGS Teleost* equipped with a Campelen shrimp trawl (Bourdages et al. 2015).

Comparative fishing experiments were conducted in 1990 and 2005 but conversion factor have not been developed for Winter Skate due to very low catches for this species (Bourdages et al. 2007).

WINTER SKATE CATCHES IN THE NGSL AUGUST SURVEYS

From 1984 to 2015, only 58 Winter Skate were reported in the nGSL August surveys (Table 1). These 58 Winter Skate were captured in 38 of 7,148 fishing tows (0.5%), and in only 12 of the 31 years of the survey. There has been no reported Winter Skate catches since 2008. These catches are too infrequent to generate an index of abundance in the nGSL area. The size range for these skates was between 9.7 and 65 cm with an average of 24.4 cm.

According to Dutil et al. 2006 and Nozères et al. 2015, misidentifications of skates have occurred in the nGSL DFO survey. On occasion, Thorny Skate and Round Skate may have been misidentified as Winter Skate, due, in part, to the presence of a spotted pattern on Thorny Skate.

It is important to confirm records of Winter Skate in the nGSL groundfish surveys and especially to confirm the presence of Winter Skate in the nGSL in the context of species at risk. Records of Winter Skate were reviewed using:

1) available survey photos,
2) survey catches with depth and location data, and
3) individual weight-length data.

Photographic identification

Skates of unusual size or appearance were occasionally photographed on the DFO survey. A review of the photos revealed three examples of misidentified individuals. On the 2004 DFO survey (Table 1 #42, Figures 5 and 6), a juvenile Round Skate (*Raja fyllae*) collected in NAFO Division 4R at 434 m depth was misreported as a Winter Skate. Worth mentioning is another example of a juvenile Round Skate that was misidentified as a Winter Skate but had been corrected prior to this present photo identification exercise. This specimen is misreported in the *Identification guide for marine fishes of the estuary and northern Gulf of St. Lawrence and sampling protocols used during trawl surveys between 2004 and 2008* (Nozères et al. 2010). A second case that could be corrected was of a 2005 Thorny Skate initially misreported as a Winter Skate (Table 1 # 52, Figures 6, 7). Finally, this photo identification process has also permitted to confirm the identification of a true Winter Skate that was originally identified as a Round Skate (Table 1 # 58, Figure 8). The specimen, a large female of 683 mm weighing 2,568 g was sampled in 2008 at 88 m depth off the west coast of Newfoundland, NAFO Division 4R (Figure 6). Large female Winter Skate are rare in the sGSL population and would not be found at that depth.

Depths and geographic locations of catches

Winter Skate is reported to be most frequently captured in water shallower than 111 m (Bigelow and Schroeder 1953), but has occasionally been caught in water depths of more than 200 m for example, in the Gulf of Maine and the southern Gulf of St. Lawrence (sGSL). Most catches of skate (55 out of 58) recorded as Winter Skate during the summer nGSL survey were from depths greater than 111 m (usually 200-400) (Table 1, Figure 7). Mean depth of capture was 302 m. This could suggest that these skates were likely misidentified and could be Thorny, Smooth or Round Skates, which are species found in deeper waters. The photo identification

process has shown such a case, where a Thorny Skate was first misreported as a Winter Skate (Figure 7).

DFO Science performed two distinct groundfish surveys in the Gulf of St. Lawrence. The DFO Quebec Region surveys the northern portion while the DFO Gulf Region covers the southern portion (sGSL). There is an area of overlap between those two surveys along the southern slope of the Laurentian channel (Figure 9). Within this overlapping area, there are some strata where Winter Skate were caught in the sGSL survey and not in the nGSL survey. These catches are however low and totalize 20 Winter Skate captured in the sGSL surveys (Figure 10) for the period 1984-2014. It is not known if the difference in the timing of surveys, August for the nGSL and September for the sGSL, could explain this difference. Problematic skate identification issues reported for the nGSL surveys might also be present in the sGSL surveys.

Winter Skate in the sGSL is also reported to be in shallower waters in the summer time and migrating into deeper waters in winter time. Based on data provided by D. Swain (DFO, Gulf Region) the median depth of Winter Skate captures in September in the sGSL DFO survey is 30 m. In the nGSL, the minimum water depth surveyed during the August DFO survey is 37 m, and only 15% of the area surveyed has water depth between 37 and 91 m. Shallow areas of less than 37 m in Divisions 4R and 4S could be potential Winter Skate habitat. The area of such habitat (< 37 m water depth) is small (9,235 km^2) and represents less than 8% of the total 4RS area (122,913 km^2). The QC DFO survey covers 96,565 km^2 which represent 79% of the total 4RS area.

Information from inshore surveys conducted on the north shore, Division 4S revealed no catches of Winter Skate. Sites were from the Baie Sainte-Marguerite crab survey (Sainte-Marie et al. 1996, Émond et al. 2015), the Mingan scallop survey (DFO 2005a, Patrice Goudreau DFO, Mont-Joli, pers. comm.) and eelgrass monitoring surveys (Nellis et al. 2012). Locations where these surveys took place are shown in figure 1.

Weight-length relationship

An attempt was made to ascertain species identification based on biological characteristics (individual weight-length) of skates. Of the 58 skates reported as Winter Skate in the nGSL survey database, weight and length were available for 44 specimens. The information of these 44 skates was plotted against weight-length (W.-L.) relationship curves of sGSL Winter and Thorny Skates, 4VW Winter Skate and, nGSL Smooth and Thorny Skates (Figure 11). Data from the sGSL skates were provided by D. Swain (DFO Gulf Region), and data from 4VW Winter Skates were provided by M. Showell (DFO Maritimes Region). The majority of larger skates (> 45cm) survey-identified as Winter Skate in fact fell on the Thorny Skate W.-L. curve, while the smaller ones (< 15 cm) fell on the Smooth Skate W.-L. curve (Figure 11). The 2008 photo identified Winter Skate and the 1988 Winter Skate museum collection specimen both fell on the Winter Skate W.-L relationship. Moreover, the 2005 photo identified Thorny Skate fell on the Thorny Skate W.-L. curve.

As mentioned in the section *Depths and locations of catches*, both the DFO Quebec survey and the DFO Gulf survey sample a common area in NAFO Division 4T (Figure 10). In this overlapping area, skates identified as Winter Skate were caught in the Gulf survey and not in the Quebec survey. When W.-L. data for the Winter Skates sampled in the overlapping area were plotted against regression curves of sGSL Thorny and Winter Skates, some skates fell closer to the Thorny Skate W.-L curve than the Winter Skate curve (Figure 12). This might suggest that identification of Winter Skate is problematic on several surveys. However, as Winter Skates were more common in the sGSL, DFO Gulf region scientists performing the sGSL survey would have more experience and skills at correctly identifying this species.

Out of the 44 nGSL fish reported as Winter Skates, only three specimens fell close to the Winter Skate W.-L. relationship. They were caught in water depths of 83, 203 and 405 m. It is important to note that there is some overlap in W.-L. data between Winter and Thorny Skates (Figure 12) and therefore determining skate species based on W-L relationship is not without error, and it is even more problematic for smaller individuals.

Additional information

Table 1 shows that during the 2004 Teleost survey, 8 juvenile Winter Skate (# 43-50) were reported in a single set. This is most unlikely due to the rare presence of this species and the difficulty in small skate identification. These 8 skates were likely misidentified Thorny Skate.

The work done to try to ascertain the identification of Winter Skate a posteriori has proven to be very difficult and only a few identifications could be confirmed. This exercise, in particular the W.-L. evaluation, suggests that there may be less Winter Skate in the nGSL than previously reported and that most of these skate were Thorny, Smooth and Round Skates.

OTHER SURVEYS

NGSL *GADUS* JANUARY SURVEY 1978-1994

The *Gadus Atlantica* survey was conducted yearly in January from 1978 to 1994 with an Engels 145 trawl (no survey in 1982). The area surveyed was highly variable over the series, mainly due to ice cover. Coverage of NAFO Subdivision 3Pn and Division 4R was good over the series while coverage of Divisions 4T and 4S was more variable. The St. Lawrence estuary was not surveyed.

In the *Gadus Atlantica* survey, Winter Skate were recorded in less than 7% of the sets (156 / 2,353 sets) (Simon et al. 2003). Large captures with ≥ 200 individuals were reported in 1980, 1984 and 1986. These large catches are considered suspicious. Winter Skates were reported at depths ranging from 62 to 510 m, with an average depth of 269 m. Lengths were only collected from 46 individuals in 1993 and 1994. Their size ranged from 26 to 89 cm, with an average of 55 cm. No individual weights were collected. This exercise did not result in any firm conclusion to ascertain the identification of the skates reported as Winter Skate in the January survey.

SENTINEL PROGRAM - MOBILE AND FIXED GEAR SURVEYS

A sentinel program was put in place in 1994 in the nGSL. This program has two components; a mobile survey with a design similar to the DFO nGSL August survey and a fixed gear program. Between 1995 and 2015, Winter Skates were only reported caught in 0.2% of sets done during the mobile sentinel survey (12 out of 6,006 sets). Data from the fixed gear sentinel program were not examined because skate are mainly reported as skate sp.

DESIGNATABLE UNIT ASSIGNMENT OF WINTER SKATE OF THE ESTUARY AND NORTHERN GULF OF ST. LAWRENCE

In the 2015 COSEWIC assessment and status report on the Winter Skate (*Leucoraja ocellata*), three designatable units (DU) were defined based mainly on the criteria of physical discontinuity between concentrations of Winter Skate. A Gulf of St. Lawrence DU including Winter Skate from the northern and southern Gulf of St. Lawrence was proposed. Although there is a well-defined Winter Skate population in the sGSL, this species is very rarely captured in surveys of the nGSL. The sGSL Winter Skates have unique life history characteristics. They differ from Winter Skate on the Scotian Shelf and areas further south by their smaller size at maturity, 42 cm

compare to 75 cm, and a much shorter maximum length, and are present in warmer shallower waters in summer.

Information is available for only three specimens of Winter Skate in the nGSL to provide insight as to which type they belong to, i.e., the smaller maturing type of the sGSL or the larger maturing type of the Scotian Shelf area. A specimen of mature 49.5 cm male Winter Skate caught in 1988 in the Estuary (Figure 2) exhibits characteristics compatible with the sGSL Winter Skate population. Since the St. Lawrence Estuary is part of NAFO Division 4T this Winter Skate could be a vagrant individual caught outside of the normal range of the sGSL Winter Skate.

A second specimen for which maturity information can be derived from its photo is an immature male of 54 cm captured in Bonne Bay fjord located off the west coast of Newfoundland (Figure 3). At this length, sGSL males would be expected to be mature whereas males occurring elsewhere would be immature. This specimen would be of the late-maturing type and not of the sGSL population.

Finally, although no maturity data is available for the 2008 large female Winter Skate (Figure 8), its size of 69.5 cm and the depth at which it was caught (88 m) would favor this specimen to be part of the late-maturing population. Female Winter Skate larger than 70 cm have not been reported in the sGSL DFO RV survey since 1972 and the average depth where Winter Skate are caught is 30 m.

In conclusion, Winter Skate are extremely rare in the nGSL. The very limited number (3) of confirmed individuals for which biological information and maturity data are available would indicate that the small-maturing sGSL type was found once in the St. Lawrence Estuary and that the late-maturing type is present on the west coast of Newfoundland and in the Bonne Bay fjord.

FISHERY

COMMERCIAL FISHERY

Reported landings of unspecified skate species in the nGSL, NAFO Divisions 4R and 4S, were compiled using ZIFF (Zonal Interchange File Format) data files for the period 1985-2015. In these files, skate species are not determined and landings are reported as unspecified skate. Based on the proportion of the different skate species found in the nGSL DFO surveys, it is concluded that the vast majority of skates landed in 4R and 4S are Thorny and Smooth Skates. Landings of Winter Skate are considered to be negligible in Divisions 4R and 4S.

Between 1985 and 2015, reported landings of unspecified skate averaged less than 2 t per year in NAFO Division 4S and 48 t in Division 4R (Table 2). Reported landings in Division 4S are mainly from the Greenland Halibut gillnet fishery (Figure 14).

In Division 4R, from 1994 to 1997 there were on average 118 t of skate landed from gillnet fisheries targeting for unknown species (Figure 15). For the period 1998-2008, most of the skate landings are reported from a small skate directed fishery using gillnet. Landings from this skate fishery peaked at 165 t in 1999 with an annual average catch of 78 t for the period 1998-2003. There have been no reported landings in this skate fishery in 2004, 2006 and from 2009 to 2015. Since 2009, reported skate bycatch in 4R has been mainly from Cod (*Gadus morhua*), Lumpfish (*Cyclopterus lumpus*), Greenland Halibut (*Reinhardtius hippoglossoides*), and American Plaice (*Hippoglossoides platessoides*) directed fisheries (Figure 15). Reported skate bycatch were caught mainly with gillnet. Overall, reported landings of skates in Divisions 4R and 4S are low and landings for Winter Skate are considered negligible.

OBSERVER DATABASE

Bycatch of skates was also examined using the at-sea observer database for the period 1999-2015. Ten species of skates are reported as being caught in NAFO Divisions 4R and 4S for this time period. They are in order of frequency, Thorny Skate (70%), Spinytail Skate (18%), Smooth Skate (9%), Winter Skate (2%), Barndoor Skate, Little Skate, Shorttail Skate, Arctic Skate, White Skate and Round Skate. Unspecified skate (Skates sp.) is reported as the second most frequent representing 29% of total skate. Arctic Skate and White Skate have not been reported in the DFO RV survey. Other skates, as indicated in Dutil et al. 2006, have yet to be confirmed in the northern Gulf of St. Lawrence. These include Barndoor Skate, Soft Skate and Shorttail Skate. Problematic identification of skate species in the observer database has been raised in Benoît (2006).

Bycatch of Winter Skate in the shrimp fishery.

Since the mandatory use of a separator grate in 1993 on the shrimp trawls, bycatch is exclusively composed of small individuals. Marine organism identification is a difficult exercise for non-commercial species or species that are rarely caught, especially when specimens are small as they are in the shrimp fishery bycatch. In spite of this problematic identification of small skate, an estimation of Winter Skate bycatch in the shrimp fishery was done assuming Winter Skate were correctly identified (Savard et al. 2013, Bourdages and Marquis 2014). For the period 2000-2013, bycatch of small Winter Skate was reported by the observers and could have been less than 200 kg annually. For the month of August, average depth of Winter Skate bycatch in the shrimp fishery is 262 m. These depths are covered by the nGSL DFO August survey where no Winter Skate has been caught since 2008. Bycatch of Winter Skate is considered to be negligible in the shrimp fishery.

CONCLUSION

Although the presence of Winter Skate in the nGSL has been documented in the literature (Bigelow and Schroeder 1953, McEachran and Musick 1973), confirmed by one specimen in Maurice Lamontagne Institute museum collection (1988 Rivière-du-Loup), one individual caught during the Quebec Region DFO groundfish survey (2008), and ten specimens collected in the Bonne Bay Fjord, this specie appears to be very rare.

The work done to try to ascertain, a posteriori, the identification of Winter Skate has proven to be very difficult and only a few identifications could be confirmed. Moreover this exercise tends to indicate that there are even less Winter Skates in the nGSL than previously reported and that identification of Winter Skate has been problematic.

The very limited number of individuals (3) for which biological information and maturity data are available would indicate that the small-maturing sGSL Winter Skate type can be found in the St. Lawrence Estuary, Division 4T, and that the late-maturing type is present on the west coast of Newfoundland and in the Bonne Bay fjord, Division 4R.

Reported landings of unspecified skate in Divisions 4R and 4S are low. Based on the proportion of the different skate species found in the nGSL DFO surveys, it is concluded that the vast majority of skates landed in Divisions 4R and 4S (>98%) are Thorny (76%) and Smooth Skates (22%). Landings of Winter Skate are considered to be negligible in Divisions 4R and 4S. Bycatch of Winter Skate is also considered to be negligible in the Gulf of St. Lawrence shrimp fishery.

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Table 1. Skate reported as Winter Skate in the northern Gulf of St. Lawrence survey

#	Vessel[1]	Year	NAFO	Stratum	Set	Lat	Long	Catch (kg)	Depth (m)	Temp (°C)	Length (mm)	Sex[2]	Weight (g)	Photo ID
1	L. H.	1984	4R	801	31	5002	5855	1.4	291	4.9				
2	L. H.	1986	4S	804	129	4901	6319	1	396	5.8				
3	L. H.	1986	4S	804	129	4901	6319	1	396	5.8				
4	L. H.	1986	4S	804	129	4901	6319	1	396	5.8				
5	A.N.	1994	4S	814	70	4952	5927	0.01	255	5.8	100	9	10	
6	A.N.	1994	4S	814	72	4943	5938	0.01	271	6.2	100	9	10	
7	A.N.	1994	4R	812	73	4936	5943	0.02	276		130	9		
8	A.N.	1994	4R	812	73	4936	5943	0.02	276		110	9		
9	A.N.	1995	4T	404	4	4803	6059	0.01	340		130	9	20	
10	A.N.	1995	4S	808	88	4860	6007	0.01	284		100	5	10	
11	A.N.	1998	4R	810	47	4816	5948	0.02	281	5.2	116	5	20	
12	A.N.	1998	4R	810	50	4825	5953	0.01	319	5.3	100	1	10	
13	A.N.	1998	4R	812	69	4917	5921	0.01	230	5.4	112	1	10	
14	A.N.	1999	3Pn	303	11	4724	5850	0.01	232	6.4	91	1	10	
15	A.N.	1999	4R	809	61	4851	5950	0.01	305	5.5	94	5	10	
16	A.N.	1999	4R	813	79	5021	5742	0.16	206	4.8	267	9	160	
17	A.N.	1999	4S	815	118	4917	6009	0.01	266	5.5	130	5		
18	A.N.	1999	4S	815	118	4917	6009	0.01	266	5.5	117	5		
19	A.N.	1999	4R	812	119	4922	5953	1.45	252	5.5	256	5		
20	A.N.	1999	4R	812	119	4922	5953	1.45	252	5.5	492	5		
21	A.N.	1999	4R	812	119	4922	5953	1.45	252	5.5	560	5		
22	A.N.	1999	4S	803	127	4824	6029	2.38	428	5.1	600	1		
23	A.N.	1999	4S	803	127	4824	6029	2.38	428	5.1	92	9		
24	A.N.	1999	4S	803	128	4830	6057	0.01	405	5.0	118	1	10	
25	A.N.	2000	4S	819	245	4848	6111	1.62	280	5.6	538	1	1620	
26	A.N.	2000	4S	806	260	4903	6311	1.41	349	5.4	425	1	1410	
27	A.N.	2002	4S	808	116	4860	6011	0.005	282	5.7	110	5	5	
28	A.N.	2003	3Pn	304	26	4725	5906	0.37	357	5.5	414	5	370	
29	A.N.	2003	3Pn	304	31	4728	5914	0.59	312	6.1	462	5		
30	A.N.	2003	3Pn	304	31	4728	5914	0.59	312	6.1	87	5		
31	A.N.	2003	3Pn	304	31	4728	5914	0.59	312	6.1	119	1		
32	A.N.	2003	4T	401	58	4804	6107	1.83	269		571	1	1830	

#	Vessel[1]	Year	NAFO	Stratum	Set	Lat	Long	Catch (kg)	Depth (m)	Temp (°C)	Length (mm)	Sex[2]	Weight (g)	Photo ID
33	A.N.	2003	4R	802	63	4800	5959	1.14	499	5.3	607	1	1140	
34	A.N.	2003	4R	802	64	4802	5958	0.02	484		120	5		
35	A.N.	2003	4R	802	64	4802	5958	0.02	484		122	5		
36	A.N.	2003	4T	413	155	4840	6845	0.7	343	5.2	489	1	700	
37	A.N.	2003	4R	809	209	4905	5951	0.01	286	6.0	95	1	10	
38	A.N.	2004	4T	406	131	4855	6339	1.8	312		556	1	1785	
39	A.N.	2005	4R	836	57	4927	5821	1.35	51		486	9	1350	
40	A.N.	2005	4T	409	137	4916	6617	0.0031	235		93	9	3	
41	A.N.	2005	4T	409	138	4911	6639	0.0046	247		103	1	5	
42	Tel.*	2004	4R	802	5	4740	5937	0.01	434	4.9	110	9	5	Round S.
43	Tel.	2004	4R	810	11	4810	5952	0.05	341	5.5	105	5	5	
44	Tel.	2004	4R	810	11	4810	5952	0.05	341	5.5	96	1	4	
45	Tel.	2004	4R	810	11	4810	5952	0.05	341	5.5	135	1	10	
46	Tel.	2004	4R	810	11	4810	5952	0.05	341	5.5	120	5	7	
47	Tel.	2004	4R	810	11	4810	5952	0.05	341	5.5	101	5	5	
48	Tel.	2004	4R	810	11	4810	5952	0.05	341	5.5	131	1	12	
49	Tel.	2004	4R	810	11	4810	5952	0.05	341	5.5	115	1	7	
50	Tel.	2004	4R	810	11	4810	5952	0.05	341	5.5	109	5	5	
51	Tel.	2004	4R	835	21	4844	5923	0.25	83	0.4	411	1	438	
52	Tel.**	2005	4T	411	155	4908	6731	1.33	292	5.3	506	1	1325	Thorny S.
53	Tel.	2005	4S	827	195	4943	6019	4.35	123	0.9	516	5	1450	
54	Tel.	2005	4S	827	195	4943	6019	4.35	123	0.9	481	5	1270	
55	Tel.	2005	4S	827	195	4943	6019	4.35	123	0.9	520	5	1655	
56	Tel.	2005	4S	815	198	4936	6020	0.05	203	4.7	187	5	45	
57	Tel.	2006	4R	810	10	4744	5935	0.00	375	5.5	97	1	4	
58	**Tel.*** **	**2008**	**4R**	**835**	**29**	**4834**	**5920**	**2.5**	**88**	**0.2**	**683**	**5**	**2598**	**Winter S**

[1] *Vessel: L.H. = Lady Hammond, A.N. = Alfred Needler, Tel. = Teleost*

[2] *Sex: 1 = male, 5 = female, 9 = unknown or immature*

**Skate first recorded as a Winter Skate and confirmed as being a Round Skate based on photo identification*

***Skate first recorded as a Winter Skate and confirmed as being a Thorny Skate based on photo identification*

****Skate first recorded as a Round Skate and confirmed as being a Winter Skate based on photo identification*

Table 2. Reported landings (t) of unspecified skate in the commercial fishery in the northern Gulf of St. Lawrence, NAFO Divisions 4RS.

	4R		4S	Total
Year	Directed	Bycatch	Bycatch	
1985		0	3	3
1986				0
1987		17		17
1988			1	1
1989		0	0	0
1990		4	1	4
1991		3	0	3
1992		26	0	26
1993	1	0	1	2
1994	0	86	3	89
1995		149	0	150
1996		106	6	112
1997		146	4	150
1998	105	46	3	153
1999	165	45	1	212
2000	79	74	1	154
2001	47	29	0	77
2002	49	22	0	71
2003	23	39	1	63
2004		1	5	6
2005	3	10	8	22
2006		26	4	30
2007	3	31	2	37
2008	5	20	2	27
2009		10	3	12
2010		10	2	12
2011		7	1	8
2012		9	1	10
2013		3	1	4
2014		2	1	2
2015*		2	1	3

*Preliminary data

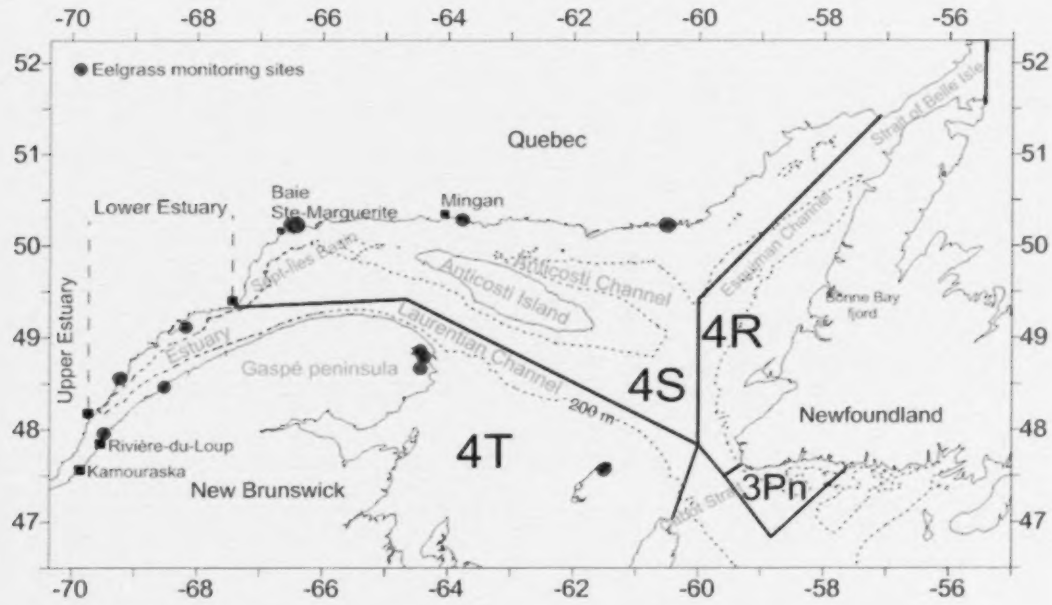

Figure 1. Gulf of St. Lawrence with NAFO Divisions and locations cited in the research document.

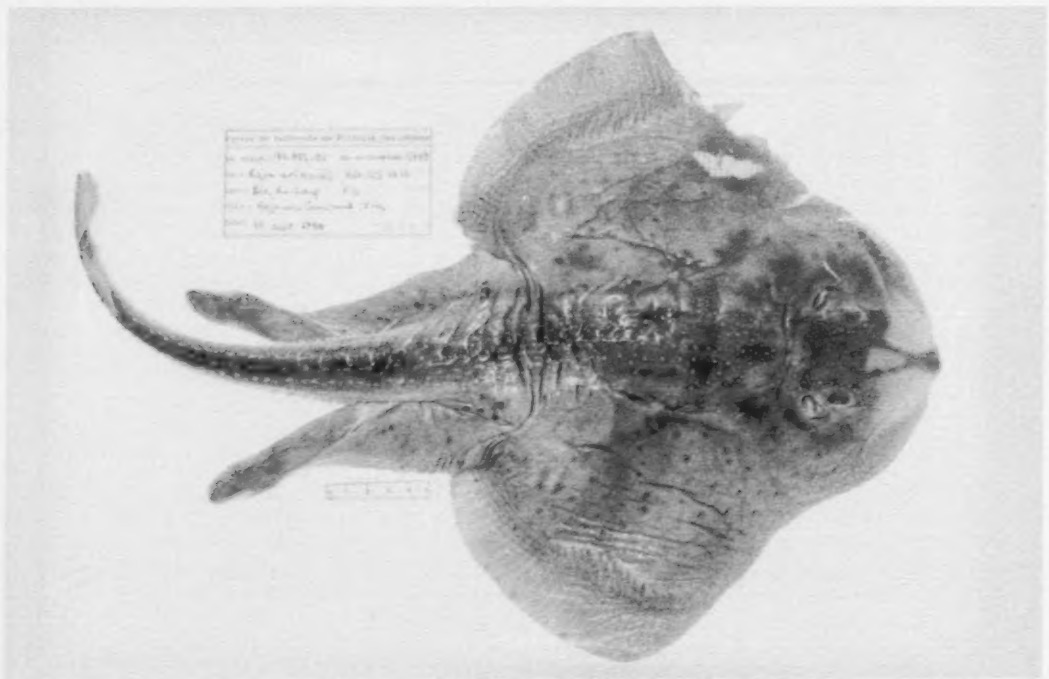

*Figure 2. Winter Skate (*Leucoraja ocellata*) collected in 1988 from Rivière-du-Loup, Québec (St. Lawrence Lower Estuary). Mature male specimen, 49 cm total length. Scale bar = 5 cm. Maurice Lamontagne Institute museum collection. Photo: C. Nozères.*

Figure 3. Immature male Winter Skate (Leucoraja ocellata) collected from Bonne Bay fjord in July 2010 (Photos: Joe Wroblewski, Memorial University, Newfoundland).

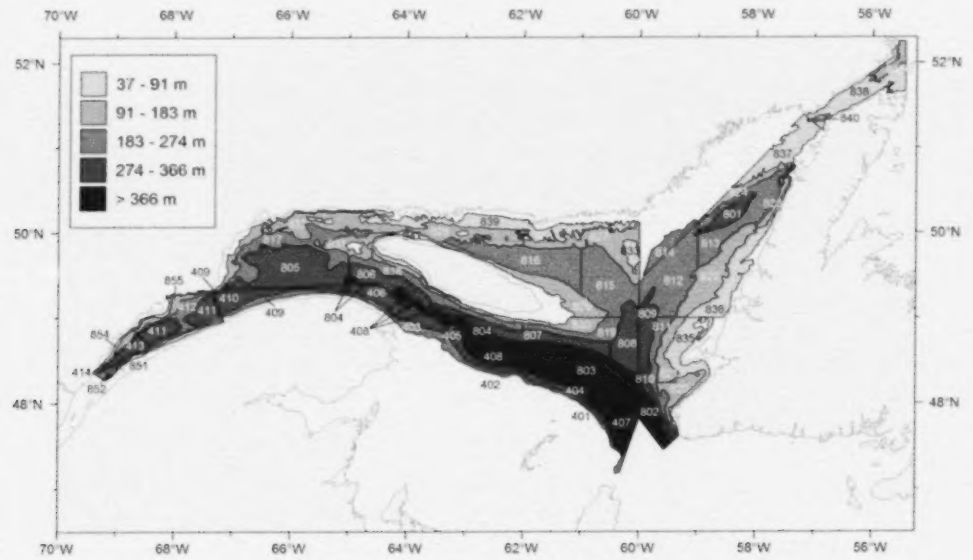

Figure 4. Stratification scheme used for the groundfish and shrimp multidisciplinary August research survey in the Estuary and northern Gulf of St. Lawrence.

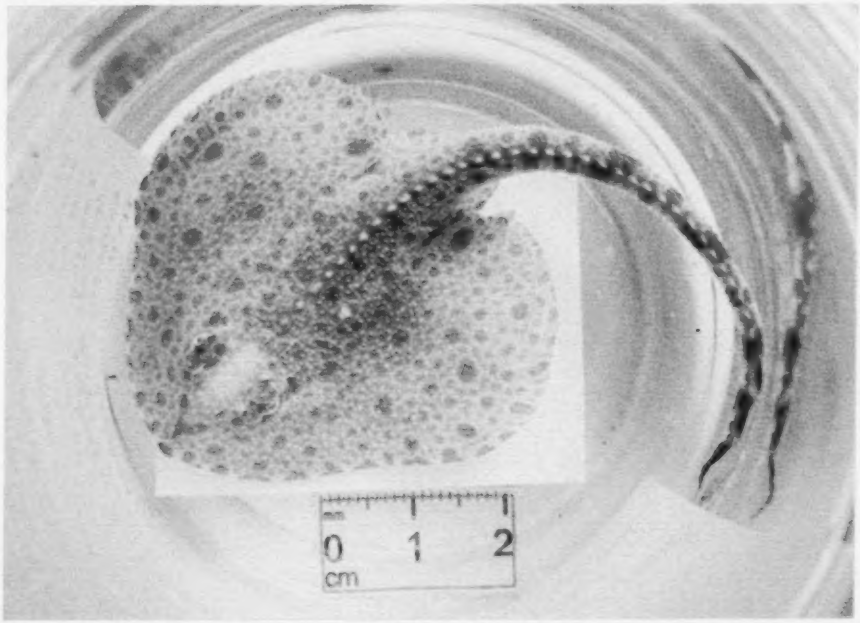

Figure 5. Example of a juvenile Round Skate (Raja fyllae), misidentified as Winter Skate (Leucoraja ocellata) on the 2004 northern Gulf survey from 434 m depth (Table 1, #42), NAFO Division 4R. Scale bar = 2 cm. Photo: C. Nozères.

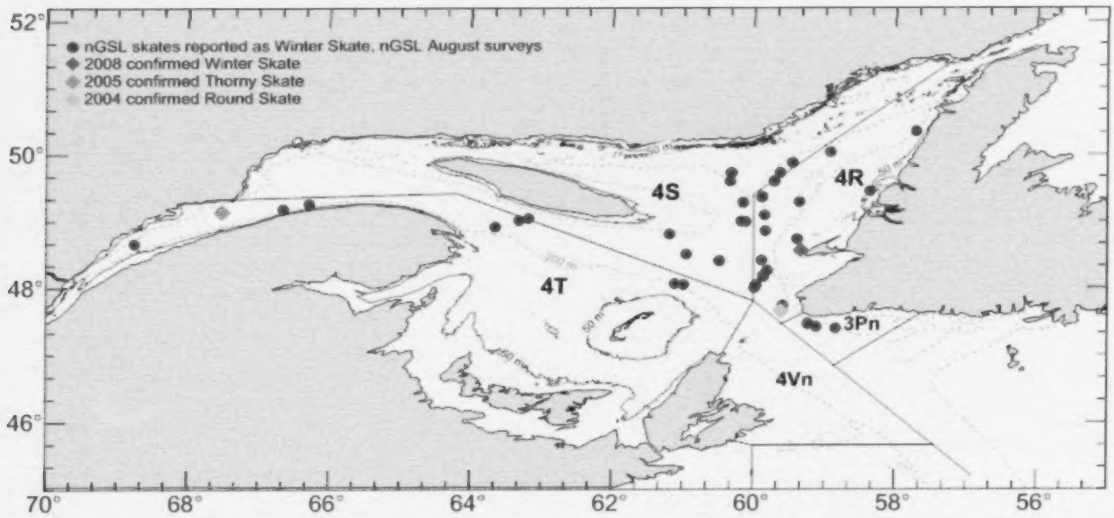

Figure 6. Distribution of skates reported as Winter Skate in the nGSL database. Green diamond shows the position of a 2004 photo-confirmed Round Skate (Table 1, # 42). Red diamond shows the position of a 2005 photo-confirmed Thorny Skate (Table 1, #52). Purple diamond shows the position of a 2008 photo-confirmed Winter Skate (Table 1, # 58). (50 and 200 meter isobaths are shown).

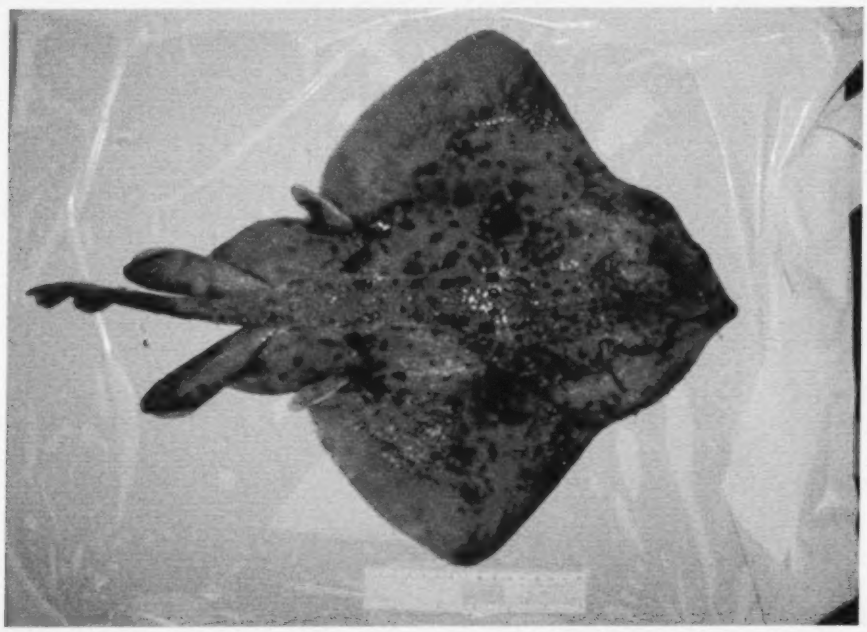

*Figure 7. Photo confirmed Thorny Skate (*Amblyraja radiata*) than was misreported as Winter Skate (*Leucoraja ocellata*) on the August 2005 northern Gulf of St. Lawrence Teleost survey (Table 1 # 52).*

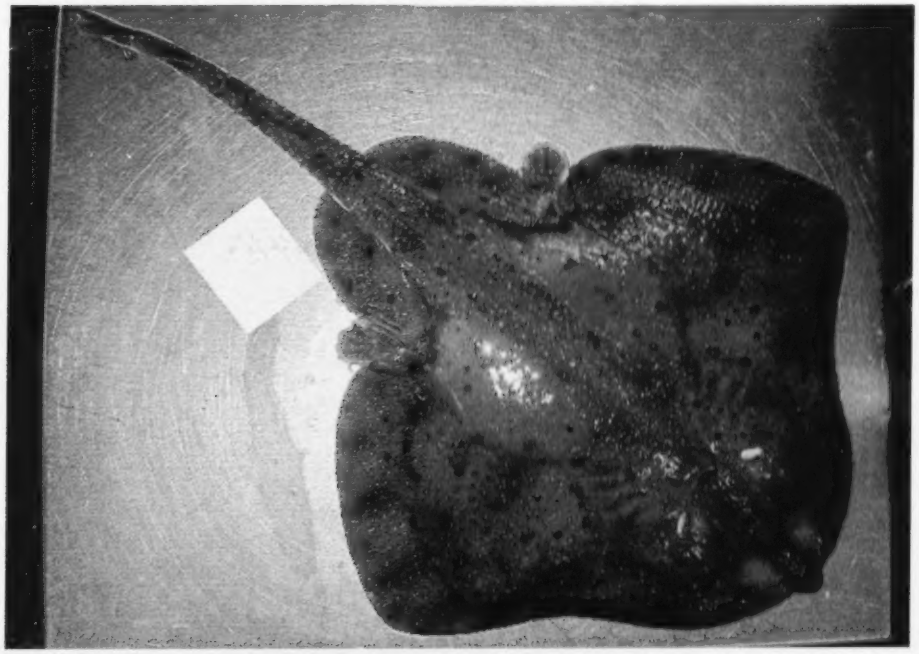

Figure 8. Large specimen (68 cm, 2.6 kg) of Winter Skate (Leucoraja ocellata) sampled on the August 2008 northern Gulf of St. Lawrence survey from 88 m depth, off of southwest Newfoundland (Table 1 # 58). Photo: Fisheries and Oceans Canada.

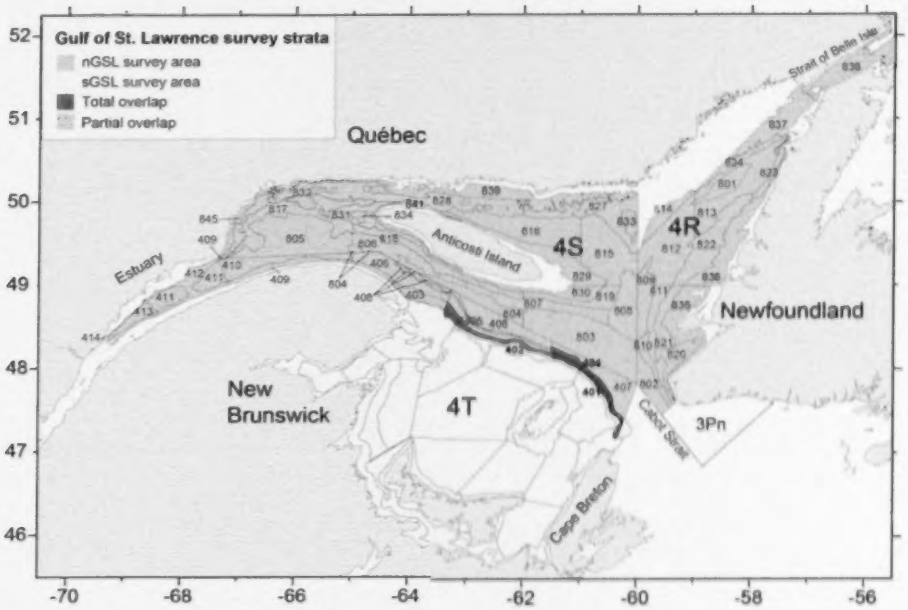

Figure 9. Northern and southern Gulf of St. Lawrence DFO groundfish survey strata. Strata numbers are shown for nGSL. Overlapping survey area in shown in water depths of 200 m and more in Division 4T.

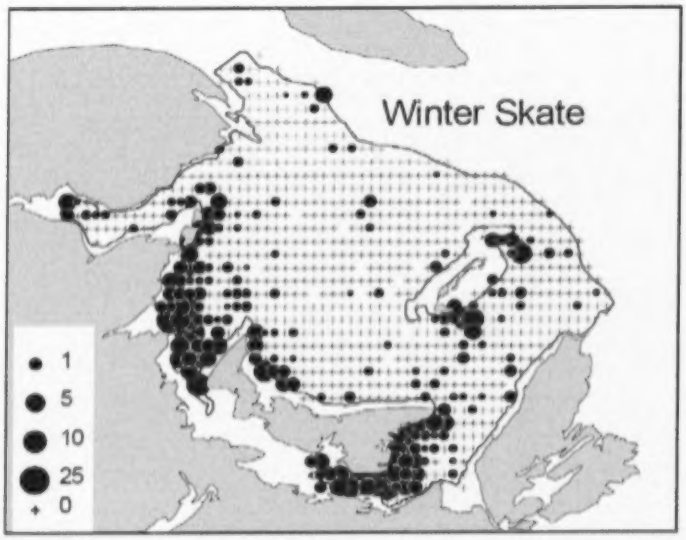

Figure 10. Distribution of Winter Skate catches (Fish/tow) in the September survey of the southern Gulf of St. Lawrence, 1971-2002 (from DFO 2005).

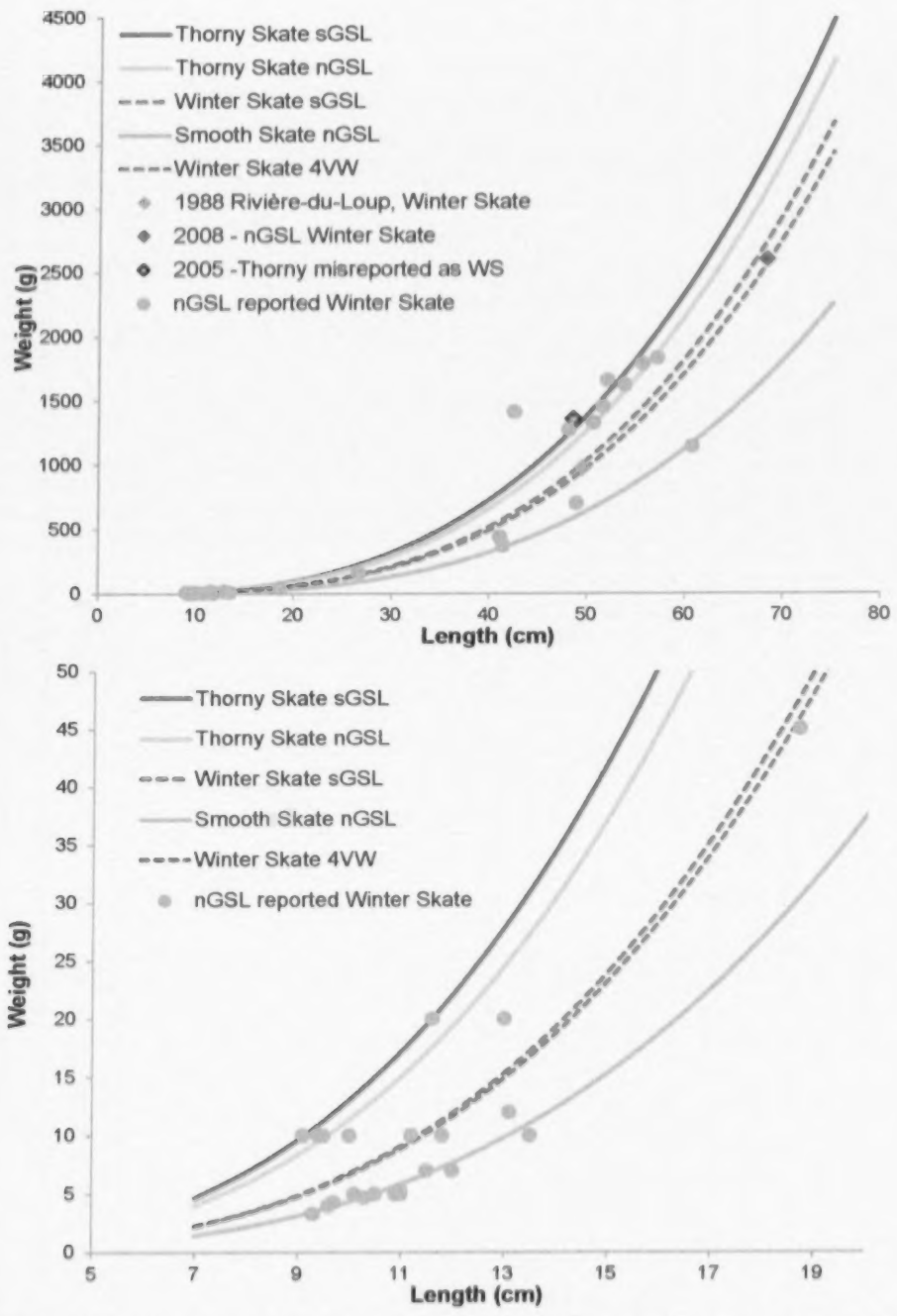

Figure 11. Weight-length data of skate reported as Winter Skate (Table 1) in the nGSL August DFO survey plotted against weight-length relationships for different skate species. The bottom panel focuses on lengths less than 20 cm. Data are from surveys in different NAFO Divisions nGSL 4RST. sGSL = 4T, 4VW.

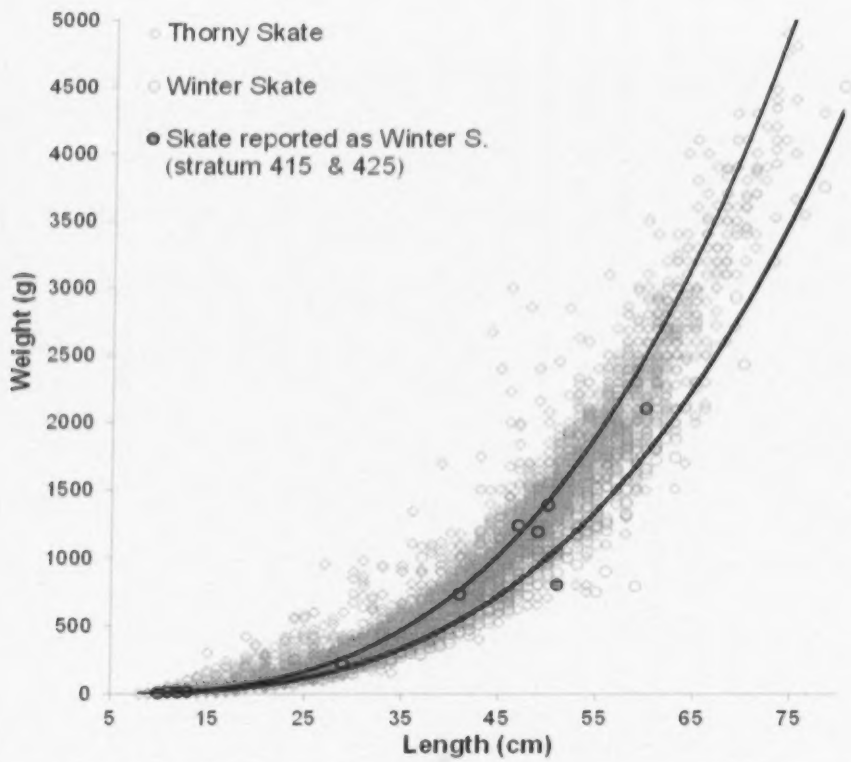

Figure 12. Individual weight-length relationship for Thorny and Winter Skates collected in the sGSL. Red dots show data for skates reported as Winter Skate and sampled in stratum 415 and 425 of the Gulf survey.

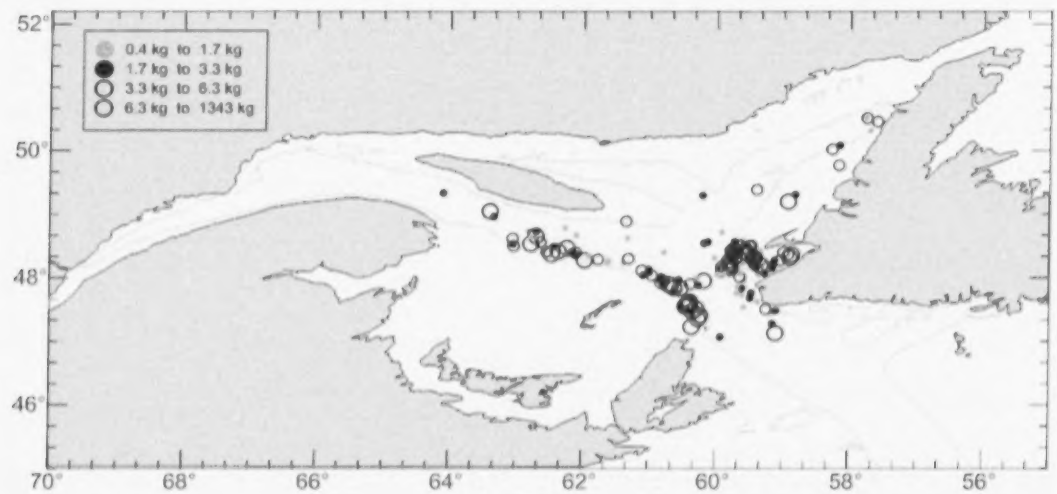

Figure 13. Distribution of skates reported as Winter Skate in the January nGSL survey, 1978-1994. 200 m isobath is shown (grey line).

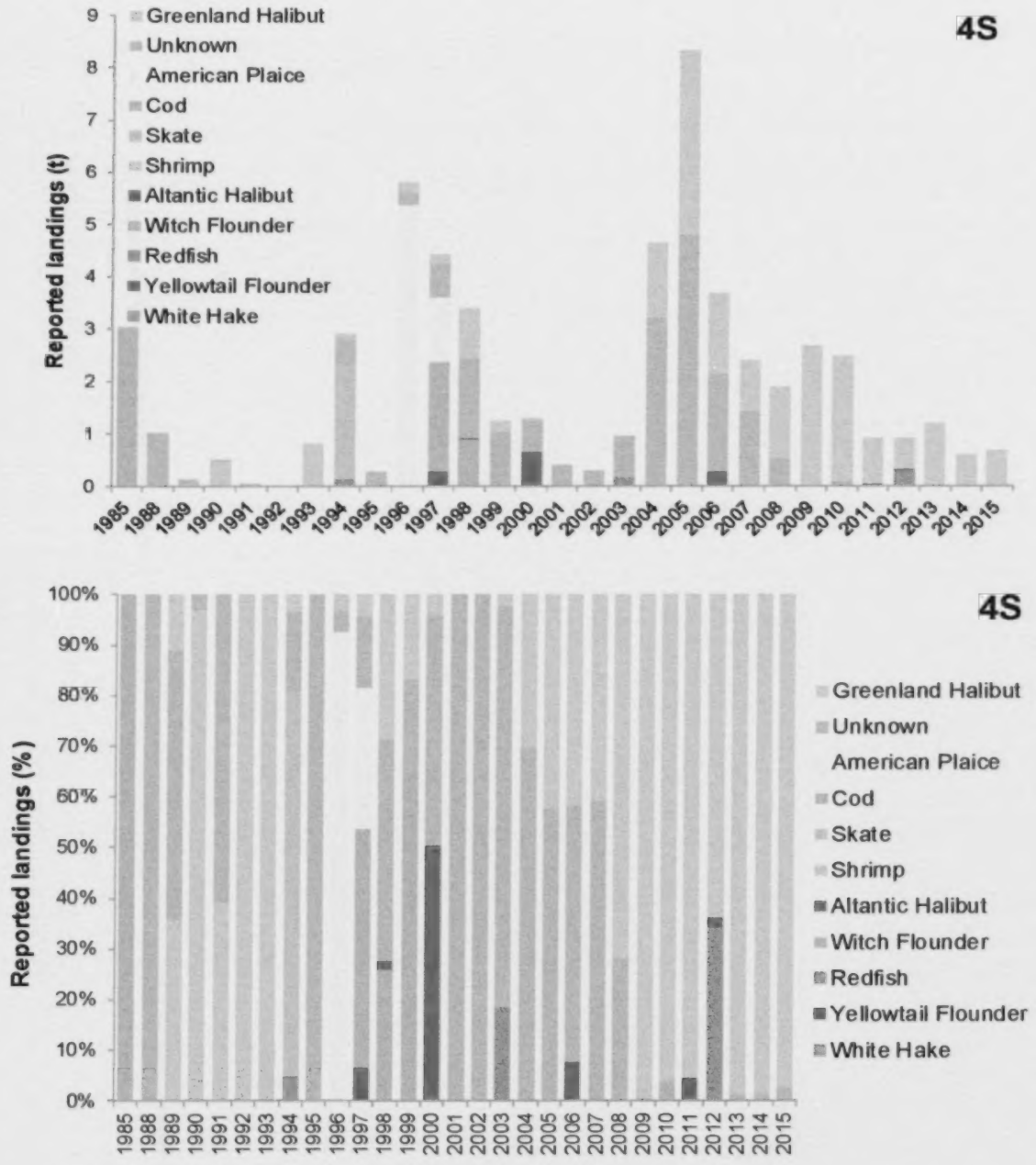

Figure 14. Reported landings (t) of unspecified skate species associated with directed fisheries in NAFO Division 4S (top panel). Bottom panel shows the same information in percentages. Data for 2015 are preliminary.

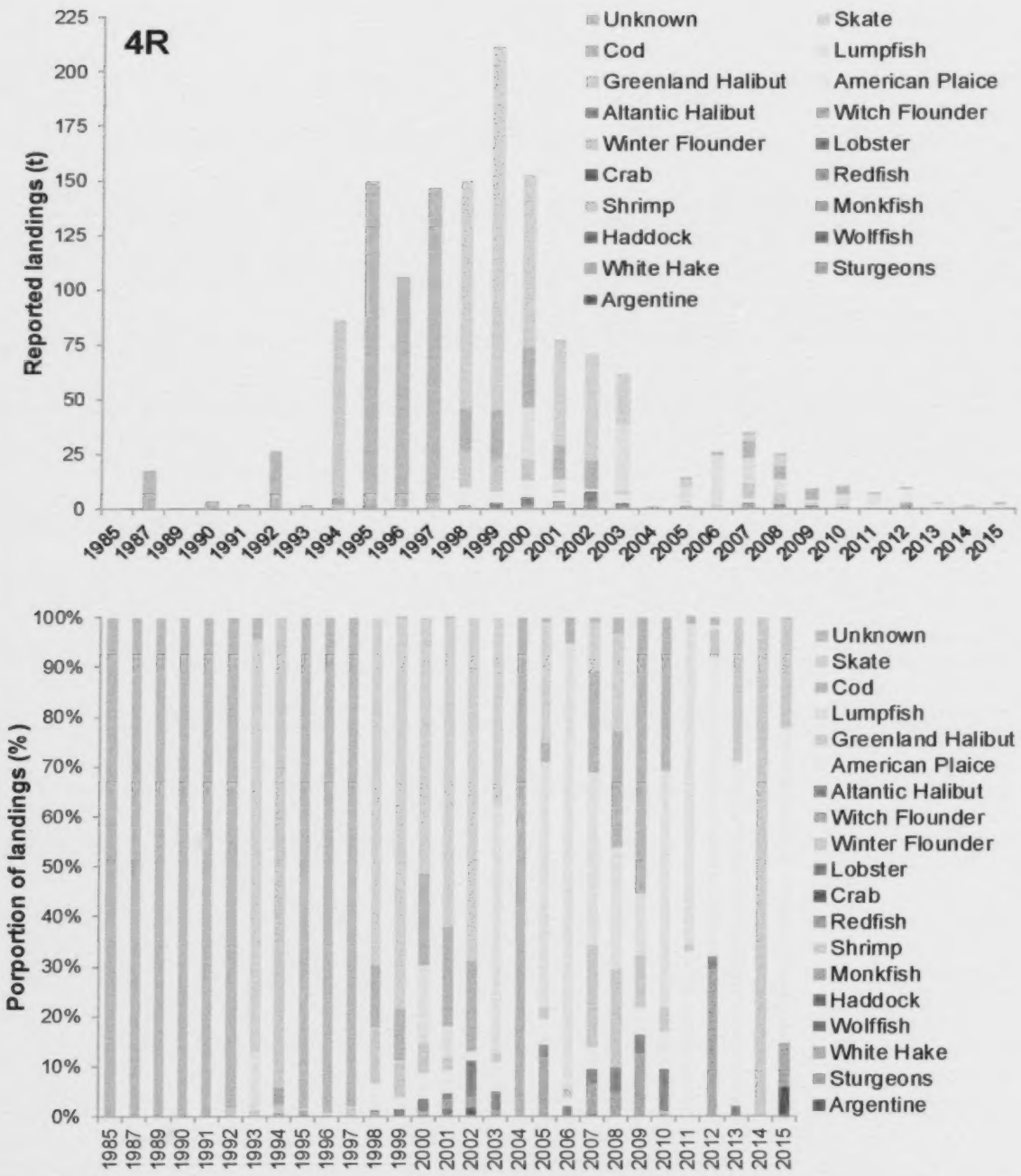

Figure 15. Reported landings (t) of unspecified skate species associated with directed fisheries in NAFO Division 4R (top panel). Bottom panel shows the same information in percentages. Data for 2015 are preliminary.